622
An32t
engrg
cop. 2

Technical Paper 340

DEPARTMENT OF THE INTERIOR

HUBERT WORK, SECRETARY

BUREAU OF MINES

H. FOSTER BAIN, DIRECTOR

PRODUCTION OF EXPLOSIVES IN THE UNITED STATES

DURING THE CALENDAR YEAR 1922

WITH NOTES ON MINE ACCIDENTS
DUE TO EXPLOSIVES

BY

WILLIAM W. ADAMS

JUL 9 1927

THE LIBRARY OF THE
JUL 22 1927
UNIVERSITY OF ILLINOIS

WASHINGTON
GOVERNMENT PRINTING OFFICE
1923

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

CONTENTS.

	Page
Introduction	1
Classification of explosives	2
Acknowledgments	2
Scope of statistics	2
Production and distribution of explosives	2
Black blasting powder	4
High explosives	4
Permissible explosives	4
Explosives in coal mining	8
Mine fatalities due to explosives	12
Monthly sales of explosives	20
Capacity of mills	22
Publications on investigations of explosives	24
Publications available for free distribution	24
Publications that may be obtained only through the Superintendent of Documents	25

Additional copies of this paper may be purchased at cost from the SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C., at 5 cents per copy.

First edition, May, 1923.

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

JUL 9 1923

PRODUCTION AND DISTRIBUTION OF EXPLOSIVES IN THE UNITED STATES DURING THE CALENDAR YEAR 1922.[1]

By William W. Adams.

INTRODUCTION.

The quantity of explosives manufactured and sold in the United States in 1922 for domestic consumption represented an increase over 1921 of 12 per cent for black blasting podwer, 6 per cent for permissible explosives,[2] and 23 per cent for high explosives other than permissibles. The actual sales were: Black blasting powder, 7,154,649 kegs of 25 pounds each; permissibles, 43,429,768 pounds; other high explosives, 209,476,084 pounds. These figures are based upon reports received by the Bureau of Mines from manufacturers of explosives; they include estimates for several companies not reporting.

The coal-mining industry used 6,190,478 kegs of black blasting powder, or 86.5 per cent of the total quantity of this class of explosives sold in 1922; 40,197,939 pounds, or 92.6 per cent of all permissibles; and 25,497,758 pounds, or 12.2 per cent of the total quantity of all other high explosives sold during the year.

Mining operations other than coal mining used 167,700 kegs, or 2.4 per cent of the total sales of black powder; 1,452,500 pounds, or 3.3 per cent of the permissibles; and 78,074,489 pounds, or 37.3 per cent of all other high explosives. The metal-mining industry is the largest single consumer of high explosives, excluding permissibles.

Railway and other construction work used 309,819 kegs, or 4.3 per cent of the black powder; 154,112 pounds, or 0.4 per cent of the permissibles; and 22,434,206 pounds, or 10.7 per cent of the other high explosives.

Miscellaneous kinds of work consumed 486,652 kegs, or 6.8 per cent of the black powder; 1,625,217 pounds, or 3.7 per cent of the permissibles; and 83,469,631 pounds, or 39.8 per cent of the other high explosives.

[1] In this publication "production" of explosives means the total sales during the year as reported by manufacturers.

[2] "Permissible explosives" are high explosives that, because of having passed certain tests prescribed by the Bureau of Mines, are considered reasonably safe for use in gaseous and dusty coal mines.

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

CLASSIFICATION OF EXPLOSIVES.

The figures tabulated herein are classified as follows:

1. *Black blasting powder.*—All black powder with sodium or potassium nitrate as a constituent is here classified as black blasting powder.

2. *High explosives.*—Dynamite and all other high explosives of various trade names and compositions, except permissible explosives, are put in this class.

3. *Permissible explosives.*—In this class are included ammonium nitrate explosives, hydrated explosives, organic nitrate explosives, and certain nitroglycerin explosives containing an excess of free water or carbon. All permissible explosives have passed certain tests of the Bureau of Mines and are not to be regarded as permissible unless used in the manner specified by the bureau.[3]

ACKNOWLEDGMENTS.

The compilation of this report is made possible by the hearty cooperation of explosives manufacturers and of Mr. C. Stewart Comeaux, secretary of the Institute of Makers of Explosives. For this cooperation the Bureau of Mines expresses its deep appreciation. The author acknowledges the assistance rendered by Miss L. S. Gerry and Miss E. V. Walters in compiling the statistical tables herein presented.

SCOPE OF STATISTICS.

The data for 1922 presented in this publication represent sales of explosives by 24 companies. Of these companies, 18 sold black blasting powder, 18 sold permissible explosives, and 18 sold high explosives other than permissibles. Some of the manufacturers operated more than one plant, so that the number of companies does not indicate the number of operating plants.

Reports of manufacturers of ammunition and fireworks are not included in this publication, because the majority of such companies purchase their explosives from the manufacturers whose production has been included in the tables herein presented. Nor does this publication include the production of nitroglycerin, except in so far as nitroglycerin is used in the manufacture of other explosives.

PRODUCTION AND DISTRIBUTION OF EXPLOSIVES.

The quantity of each of the three main classes of explosives used in each State during the calendar years 1921 and 1922 is shown in Table 1.

[3] Hall, Clarence; Snelling, W. O.; and Howell, S. P., Investigation of explosives used in coal mines, with chapter on the natural gas used at Pittsburgh, by G. A. Burrell, and an introduction by C. E. Munroe: Bull. 15, Bureau of Mines, 1912, 197 pp. Hall, Clarence, and Howell, S. P., Tests of permissible explosives: Bull. 66, Bureau of Mines, 1913, 313 pp.

Generated on 2024-09-29 22:48 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TABLE 1.—*Amount of explosives (excluding exports) manufactured in the United States and used in the various States during the calendar years 1921 and 1922.*

State.	1921			1922		
	Black blasting powder.	High explosives other than permissible.	Permissible explosives.	Black blasting powder.	High explosives other than permissible.	Permissible explosives.
	Kegs.	*Pounds.*	*Pounds.*	*Kegs.*	*Pounds.*	*Pounds.*
Alabama	127,726	3,729,954	2,580,053	189,524	6,007,360	4,292,969
Alaska	213	1,734,650	43,300	2,790	1,970,030	48,100
Arizona	7,866	4,138,071	1,250	50,527	7,772,071	43,700
Arkansas	59,101	2,133,065	127,987	51,989	1,431,761	47,300
California	67,442	11,265,854	23,700	134,362	16,877,066	24,550
Colorado	72,623	3,311,252	696,000	87,444	3,554,877	821,274
Connecticut	584	597,015	.....	597	655,515	.....
Delaware	83	47,093	250	120	43,589	.....
Florida	1,300	2,359,325	117,300	2,813	3,289,875	4,500
Georgia	7,063	444,028	.....	12,770	913,477	.....
Idaho	8,951	2,661,165	.....	14,137	3,467,835	.....
Illinois	1,316,834	4,774,887	3,169,854	1,160,865	6,421,785	2,758,300
Indiana	785,104	2,431,374	474,313	804,118	2,423,426	496,825
Iowa	244,084	2,047,464	4,350	238,779	2,105,449	19,650
Kansas	208,045	4,266,383	32,016	238,417	5,739,178	70,450
Kentucky	465,607	2,079,211	1,116,375	836,102	2,050,861	1,781,450
Louisiana	72	850,061	156,750	404	1,013,805	204,800
Maine	1,503	584,442	.....	1,734	634,177	.....
Maryland	10,082	852,497	52,000	24,095	1,385,787	221,700
Massachusetts	4,146	568,730	900	3,291	804,889	500
Michigan	6,941	11,745,511	31,000	9,101	15,601,558	44,550
Minnesota	112,417	6,550,971	.....	78,404	9,146,013	1,350
Mississippi	2,984	713,215	11,500	1,486	790,375	18,950
Missouri	138,333	6,127,477	121,200	143,573	7,467,089	79,350
Montana	74,917	2,607,757	26,360	95,797	4,755,122	33,400
Nebraska	3,382	167,920	250	3,180	179,789	.....
Nevada	3,897	2,113,800	650	14,610	2,655,445	.....
New Hampshire	267	146,100	.....	332	136,050	.....
New Jersey	1,793	1,740,170	3,625	1,660	1,813,305	.....
New Mexico	7,704	533,550	388,250	7,572	1,136,980	472,200
New York	6,420	8,847,810	414,000	13,703	10,684,021	203,500
North Carolina	21,645	1,524,595	3,850	30,288	2,703,955	7,900
North Dakota	30,154	274,725	4,350	40,448	397,500	40,500
Ohio	311,970	5,197,631	54,069	485,471	7,248,511	81,369
Oklahoma	76,704	5,035,806	413,004	114,378	9,627,558	447,598
Oregon	26,705	3,781,745	2,650	39,901	4,853,230	7,050
Pennsylvania	1,394,869	37,809,025	21,458,135	1,169,690	31,509,040	18,669,539
Rhode Island	209	75,275	.....	214	124,350	.....
South Carolina	1,714	339,400	.....	1,682	487,925	.....
South Dakota	2,851	1,295,240	.....	3,158	1,419,425	.....
Tennessee	108,909	2,323,985	235,575	143,256	2,562,340	448,575
Texas	35,927	1,828,489	84,750	56,697	2,283,517	173,600
Utah	12,680	2,591,780	898,850	19,695	3,270,710	1,639,500
Vermont	232	294,150	.....	3,761	712,921	.....
Virginia	62,753	2,531,574	387,625	112,257	3,010,958	692,350
Washington	44,478	5,743,941	769,335	58,100	7,587,874	582,925
West Virginia	413,634	3,361,061	6,740,025	553,570	3,645,083	8,552,719
Wisconsin	3,790	4,343,137	500	2,413	4,443,202	102,275
Wyoming	104,142	430,041	487,900	95,374	659,425	294,500
Total	[1] 6,400,850 [2] 160,021,250	170,952,402	41,133,851	[1] 7,154,649 [2] 178,866,225	209,476,084	43,429,768
Grand total (pounds)		**372,107,503**			**431,772,077**	
Quantity used for:						
Coal mining	5,613,435	34,231,542	38,055,650	6,190,478	25,497,758	40,197,939
Other mining	184,792	50,977,366	881,710	167,700	78,074,489	1,452,500
Railway and other construction work	163,688	18,317,333	262,545	309,819	22,434,206	154,112
All other purposes	438,935	67,426,161	1,933,946	486,652	83,469,631	1,625,217
Total	6,400,850	170,952,402	41,133,851	7,154,649	209,476,084	43,429,768

[1] Kegs of 25 pounds. [2] Pounds.

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

BLACK BLASTING POWDER.

Sales of black blasting powder in 1922 totaled 7,154,649 kegs, an increase of 12 per cent over 1921, but an amount lower than for any other year for which annual statistics have been compiled, the first year being 1912. Of the total sales, 86.5 per cent was for coal mining, 2.4 per cent for other mining, 4.3 per cent for railway and other construction work, and 6.8 per cent for miscellaneous purposes. The actual amount of black powder used for coal mining was 6,190,478 kegs, about 10 per cent more than the amount used in 1921. The increase is significant in view of the five-months strike of the coal miners during the year and reflects the increased activity in coal mining after operations were resumed in the latter part of August.

HIGH EXPLOSIVES.

Sales of high explosives other than permissibles aggregated 209,476,084 pounds in 1922, about 23 per cent more than the quantity sold in 1921. Of the total amount sold, metal mining and other mining operations (excluding coal) used 37.3 per cent, coal mining used 12.2 per cent, railway and other construction work used 10.7 per cent, and miscellaneous purposes used 39.8 per cent. The most notable increase in the consumption of high explosives in 1922 was at metal mines, which used 78,074,489 pounds as compared with 50,977,366 pounds in 1921.

PERMISSIBLE EXPLOSIVES.

The quantity of permissible explosives sold in 1922 was 43,429,768 pounds, an increase of about 6 per cent over the amount sold in 1921. Only two other years show larger sales of permissibles. In 1918 the sales aggregated 46,045,233 pounds and in 1920 they were 53,962,841 pounds. Permissible explosives, like black powder, are consumed almost entirely in coal mining. The amount used by coal mines in 1922 was 40,197,939 pounds, or 92.6 per cent of the total sales for the year. This quantity is 2,142,289 pounds, or 5.6 per cent, more than the amount used by coal mines in 1921, notwithstanding the five-months strike in 1922. In only one other year has the quantity of permissibles used for coal mining been exceeded, and in that year, 1920, the amount used was 45,222,130 pounds.

Mining operations other than coal mining used 3.3 per cent of all permissibles sold during 1922; railway and other construction work used 0.4 per cent; and miscellaneous purposes consumed 3.7 per cent.

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 2.—*Amount of black blasting powder used in the United States during 1921 and 1922, classified by use.*

[Kegs of 25 pounds each.]

Groups of States.	Black blasting powder, 1921.				Black blasting powder, 1922.			
	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.
	Kegs.	*Kegs.*	*Kegs.*	*Kegs.*	*Kegs.*	*Kegs.*	*Kegs.*	*Kegs.*
Group 1. Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont	.....	.....	55	6,302	.....	12	63	9,257
Group 2. Connecticut, New Jersey, and New York	.....	711	372	7,714	.....	3,157	1,581	11,222
Group 3. Delaware, District of Columbia, Maryland, and Virginia	59,737	105	4,966	8,110	121,799	.....	8,606	6,067
Pennsylvania	1,314,089	2,990	3,231	74,559	1,079,042	3,955	1,853	84,840
West Virginia	380,623	710	15,713	16,558	523,203	1,450	18,962	9,955
Group 4. Florida, Georgia, North Carolina, and South Carolina	1,715	2,914	16,470	10,623	2,779	2,491	27,023	15,260
Group 5. Indiana and Kentucky	1,187,665	5,022	14,650	43,374	1,561,407	4,272	13,982	60,559
Illinois	1,279,988	2,898	230	33,718	1,146,730	2,440	921	10,774
Ohio	286,833	13,749	2,532	8,856	452,154	9,758	351	23,228
Group 6. Alabama, Mississippi, and Tennessee	201,634	6,779	11,852	19,354	284,666	16,312	10,995	22,293
Group 7. Michigan, Minnesota, and Wisconsin	6,844	109,390	1,469	5,436	7,724	75,127	1,753	5,314
Group 8. Iowa, Kansas, Missouri, and Nebraska	528,180	13,491	10,885	41,288	545,211	7,378	16,738	54,622
Group 9. Arkansas, Louisiana, Oklahoma, and Texas	141,600	1,877	9,921	18,397	173,069	2,013	21,578	26,808
Group 10. Montana, North Dakota, South Dakota, and Wyoming	136,189	10,033	1,883	63,959	190,529	8,858	5,971	29,419
Group 11. Colorado, New Mexico, and Utah	62,126	5,450	5,661	19,770	80,524	4,919	15,925	13,343
Group 12. Alaska, Idaho, Oregon, and Washington	26,203	815	26,213	27,116	21,641	373	68,511	24,403
Group 13. Arizona, California, and Nevada	.....	7,819	37,585	33,801	.....	25,205	95,006	79,288
Total kegs	5,613,435	184,792	163,688	438,935	6,190,478	167,700	309,819	486,652
Grand total (kegs)	**6,400,850**				**7,154,649**			

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:44 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 3.—*Amount of high explosives used in the United States during 1921 and 1922, classified by use.*

Groups of States.	High explosives other than permissible explosives, 1921.				High explosives other than permissible explosives, 1922.			
	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Group 1. Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont	.....	32,000	190,375	1,446,322	.....	27,708	801,090	1,583,589
Group 2. Connecticut, New Jersey, and New York	.....	3,498,375	2,778,463	4,908,157	.....	4,134,186	3,306,027	5,712,628
Group 3. Delaware, District of Columbia, Maryland, and Virginia	401,250	205,750	560,425	2,263,739	544,488	191,050	957,738	2,747,058
Pennsylvania	25,765,280	185,175	1,105,034	10,753,536	15,970,437	438,098	981,491	14,119,014
West Virginia	853,841	24,850	888,736	1,593,634	957,048	.....	904,579	1,783,456
Group 4. Florida, Georgia, North Carolina, and South Carolina	1,450	451,670	1,252,792	2,961,436	40,000	1,103,921	2,495,931	3,755,380
Group 5. Indiana and Kentucky	901,205	235,400	690,833	2,683,147	1,211,586	93,050	546,525	2,623,126
Illinois	535,803	1,830,850	412,690	1,995,544	205,805	2,957,200	162,017	3,096,763
Ohio	641,421	339,775	186,816	4,029,619	1,065,768	328,974	114,707	5,739,062
Group 6. Alabama, Mississippi, and Tennessee	1,520,525	2,265,260	1,288,290	1,693,079	1,443,900	4,320,300	1,197,640	2,398,235
Group 7. Michigan, Minnesota, and Wisconsin	76,036	14,004,123	927,025	7,632,435	82,350	19,093,184	763,535	9,251,704
Group 8. Iowa, Kansas, Missouri, and Nebraska	2,096,337	5,825,540	724,728	3,962,639	1,782,962	8,211,082	759,208	4,738,253
Group 9. Arkansas, Louisiana, Oklahoma, and Texas	583,894	4,571,430	1,279,651	3,412,446	648,304	8,769,725	1,361,085	3,577,527
Group 10. Montana, North Dakota, South Dakota, and Wyoming	331,975	3,310,022	115,485	850,281	372,575	5,944,260	200,400	714,237
Group 11. Colorado, New Mexico, and Utah	303,075	2,721,000	127,735	3,284,772	302,735	6,155,855	219,370	1,284,607
Group 12. Alaska, Idaho, Oregon, and Washington	219,450	3,925,800	3,914,707	5,861,544	866,700	4,500,925	3,713,318	8,798,026
Group 13. Arizona, California, and Nevada	.....	7,550,346	1,873,548	8,093,831	3,100	11,804,971	3,949,545	11,546,966
Total (pounds)	34,231,542	50,977,366	18,317,333	67,426,161	25,497,758	78,074,489	22,434,206	83,469,631
Grand total (pounds)	**170,952,402**				**209,476,084**			

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:44 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 4.—*Amount of permissible explosives used in the United States during 1921 and 1922, classified by use.*

Groups of States.	Permissible explosives, 1921.				Permissible explosives, 1922.			
	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Group 1. Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont				900				500
Group 2. Connecticut, New Jersey, and New York		334,700		82,925		204,450	[1] 1,000	50
Group 3. Delaware, District of Columbia, Maryland, and Virginia	381,950	26,150	5,500	26,275	784,600	63,000	5,600	60,850
Pennsylvania	20,965,619	6,700	32,710	453,106	18,147,722	45,700	27,600	448,517
West Virginia	6,203,528	25,400	131,063	380,034	8,214,968		73,862	263,889
Group 4. Florida, Georgia, North Carolina, and South Carolina	1,600	97,800	3,000	18,750	7,700		350	4,350
Group 5. Indiana and Kentucky	1,445,938	9,500	1,300	133,950	2,180,195	2,900	850	93,600
Illinois	3,164,504		200	5,150	2,750,125	200		7,975
Ohio	22,725	2,000	100	29,244	4,050	10,800	16,600	49,919
Group 6. Alabama, Mississippi, and Tennessee	2,779,083	16,150	7,300	24,595	4,572,632	134,100	7,950	45,812
Group 7. Michigan, Minnesota, and Wisconsin	500	24,350		6,650		6,150	200	141,825
Group 8. Iowa, Kansas, Missouri, and Nebraska	33,016	2,450	6,250	116,100	90,350	50,400	2,550	26,150
Group 9. Arkansas, Louisiana, Oklahoma, and Texas	460,362		41,312	280,817	424,453	51,250	11,350	386,245
Group 10. Montana, North Dakota, South Dakota, and Wyoming	228,700	111,210		178,700	349,850	14,350		4,200
Group 11. Colorado, New Mexico, and Utah	1,626,100	219,700	3,350	133,950	2,105,079	792,250	[1] 100	35,745
Group 12. Alaska, Idaho, Oregon, and Washington	738,575	3,700	27,360	45,650	565,485	16,200	6,950	49,440
Group 13. Arizona, California, and Nevada	3,450	1,900	3,100	17,150		60,750	1,350	6,150
Total (pounds)	38,055,650	881,710	262,545	1,933,946	40,197,939	1,452,500	154,112	1,625,217
Grand total (pounds)	**41,133,851**				**43,429,768**			

[1] Shipments returned to manufacturer.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

EXPLOSIVES IN COAL MINING.

Mining operations generally consume about 75 per cent of all the explosives used in the United States. Coal mining consumes between 82 and 88 per cent of all black powder, from 77 to 93 per cent of permissible explosives used in this country, and from 8 to 20 per cent of other high explosives. Other mining operations (excluding coal mines and oil and gas wells) normally consume 30 to 50 per cent of all high explosives other than permissibles, 2 to 18 per cent of permissible explosives, and 2 to 4 per cent of black powder. It will thus be seen that most of the explosives used in mining operations are used at coal mines. (Tables 11 and 12.)

The main purpose of the Bureau of Mines in compiling statistics of explosives has been to show the extent to which permissible explosives were replacing other classes of explosives in mining operations and the influence of such replacement in reducing the number of mine accidents caused by explosives. It is interesting, therefore, to note the relative increase or decrease in the consumption of each of the three main classes of explosives at coal mines as compared with the production of coal. Comparative figures since 1912, given in Table 5, show a most gratifying increase in the use of permissibles. For every thousand tons of coal produced the relative amount of permissibles used, as compared with other explosives, has increased 222 per cent since 1912.

Tables 5, 6, and 7 show, for the different coal fields and regions, the annual production of coal and the quantities of each class of explosives sold for use in coal mining. It will be noted that in 1902 only 11,300 pounds of short-flame explosives were used in coal mining, whereas in 1922 the quantity of permissible explosives so used was 40,197,939 pounds.

In 1912 the quantity of permissibles consumed in the United States represented about 5 per cent of the total quantity of all kinds of explosives produced in this country, and in 1922 it was 10.1 per cent. The total amount of explosives used for the production of coal in 1922 was 220,457,647 pounds, of which 18.2 per cent was of the permissible class. (Tables 4, 5, 6, 7, 11, and 12.)

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TABLE 5.— *Yearly sales of explosives to coal mines compared with yearly production of coal.*

Year.	Production of coal (short tons).	Pounds of explosives sold to coal mines.			Pounds of explosives used per 1,000 tons of coal mined.[1]			
		Permissible explosives.	High explosives.	Black Powder.	Permissible explosives.	High explosives.	Black powder.	Total.
1901	293,299,816	.....	.....	.....	.....	.....	.....	.....
1902	301,590,434	11,300	.....	.....	.....	.....	.....	.....
1903	357,356,416	288,661	.....	.....	.....	.....	.....	.....
1904	351,816,398	608,270	.....	.....	.....	.....	.....	.....
1905	392,722,635	1,031,300	.....	.....	.....	.....	.....	.....
1906	414,157,278	1,533,575	.....	.....	.....	.....	.....	.....
1907	480,363,424	2,095,244	.....	.....	.....	.....	.....	.....
1908	415,842,698	2,108,610	.....	.....	.....	.....	.....	.....
1909	460,814,616	8,942,857	.....	.....	.....	.....	.....	.....
1910	501,596,378	11,820,836	.....	.....	.....	.....	.....	.....
1911	496,371,126	13,428,239	.....	.....	27	.....	.....	.....
1912	534,466,580	18,150,618	20,903,430	187,091,000	34	39	350	423
1913	570,048,125	21,804,285	24,143,133	184,917,075	38	42	325	405
1914	513,525,477	19,593,892	24,215,945	176,812,650	38	47	345	430
1915	531,619,487	21,841,659	22,384,025	167,513,950	41	42	315	398
1916	590,098,175	26,566,521	20,901,405	176,976,025	45	35	300	380
1917	651,402,374	32,910,397	28,262,807	235,750,300	51	43	362	456
1918	678,211,904	37,242,915	31,368,073	216,221,550	55	46	319	420
1919	553,952,259	32,840,196	29,616,383	153,490,125	59	53	277	389
1920	658,264,932	45,222,130	37,273,255	219,762,625	69	56	334	459
1921	506,395,401	38,055,650	34,231,542	140,335,875	75	68	277	420
1922	460,379,000	40,197,939	25,497,758	154,761,950	87	56	336	479

[1] The figures show the relation that the consumption of each class of explosives bears to the total quantity of explosives used in producing coal; except in the last column they do not indicate the quantity of coal broken down by any given quantity of explosives.

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 6.—*Quantity of explosives used in the different coal fields in the United States.*[1]

Coal fields and regions.	Black blasting powder (kegs).						High explosives other than permissible (pounds).					
	1917	1918	1919	1920	1921	1922	1917	1918	1919	1920	1921	1922
1. Pennsylvania anthracite field	1,430,169	1,212,172	1,018,685	923,423	954,451	505,012	16,074,125	16,709,256	17,800,259	19,278,375	22,832,825	12,480,611
2. Northern Appalachian region [2]	2,372,303	1,967,012	1,529,511	2,271,648	1,086,831	1,671,186	4,592,547	5,320,401	4,561,368	6,975,482	4,828,967	6,057,130
3. Southern Appalachian region	845,553	815,785	656,037	1,050,068	623,094	1,065,868	1,519,234	2,202,700	1,867,150	3,221,212	1,971,317	2,045,550
4. Eastern interior field	2,974,925	3,034,820	1,876,849	3,037,925	2,054,752	1,937,438	994,166	1,121,958	904,826	1,360,150	1,063,702	938,091
5. Western interior field	1,478,311	1,319,401	838,599	1,186,280	669,789	718,280	3,185,290	4,067,393	3,642,960	4,778,831	2,680,231	2,431,266
6. Rocky Mountain region	304,544	279,039	206,099	294,657	198,315	271,053	1,154,495	1,347,240	596,170	847,009	635,050	675,310
7. Pacific coast region	24,207	20,633	13,825	26,504	26,203	21,641	742,950	599,125	243,650	812,196	219,450	869,800
Total	**9,430,012**	**8,648,862**	**6,139,605**	**8,790,505**	**5,613,435**	**6,190,478**	**28,262,807**	**31,686,073**	**29,616,383**	**37,273,255**	**34,231,542**	**25,497,758**

Coal fields and regions.	Permissible explosives (pounds).										
	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
1. Pennsylvania anthracite field	2,177,172	3,294,225	4,380,635	5,037,050	5,219,032	7,298,925	7,654,250	8,579,643	8,558,690	11,921,675	7,197,596
2. Northern Appalachian region [2]	9,190,025	9,744,810	7,966,464	9,435,318	12,147,207	14,505,542	17,007,369	14,626,371	22,489,169	15,652,147	19,953,744
3. Southern Appalachian region	3,995,485	4,481,975	3,510,013	3,447,964	4,386,757	5,287,755	5,764,886	4,210,184	5,573,168	3,809,408	6,289,282
4. Eastern interior field	751,005	2,058,075	1,364,450	1,631,775	1,949,925	2,403,600	2,873,846	2,542,290	3,906,872	3,582,217	3,222,100
5. Western interior field	440,825	377,625	411,937	433,010	422,425	624,045	930,444	642,938	1,187,171	493,378	514,803
6. Rocky Mountain region	1,473,129	1,634,575	1,796,750	1,710,992	2,244,275	2,423,180	2,622,520	1,882,770	2,744,360	1,854,800	2,154,929
7. Pacific coast region	122,977	213,000	163,643	145,550	196,900	367,350	409,600	356,000	762,700	742,025	565,485
Total	**18,150,618**	**21,804,285**	**19,593,892**	**21,841,659**	**26,566,521**	**32,910,397**	**37,262,915**	**32,840,196**	**45,222,130**	**38,055,650**	**40,197,939**

[1] The various coal fields include the following States: Group 1 includes the Pennsylvania anthracite field only; Group 2 includes Pennsylvania bituminous Maryland, West Virginia, Ohio, and Virginia; Group 3 includes Alabama, Georgia, North Carolina, Tennessee, and Kentucky; Group 4 includes Illinois, Indiana, Michigan, and Wisconsin; Group 5 includes Iowa, Missouri, Arkansas, Texas, Oklahoma, and Kansas; Group 6 includes Colorado, Idaho, North Dakota, Montana, Utah, Wyoming, Nevada, South Dakota, and New Mexico; and Group 7 includes Alaska, California, Oregon, and Washington.

[2] Not including Pennsylvania anthracite field.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:44 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 7.—*Quantity of coal mined in different coal fields in the United States.*

Coal fields and regions.	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
1. Pennsylvania anthracite field...	84,361,598	91,524,922	90,821,507	88,995,061	87,578,493	99,611,811	98,826,084	88,092,201	89,598,249	90,473,451
2. Northern Appalachian region [1]..	275,991,578	294,898,633	250,627,117	269,876,970	305,651,290	314,471,558	329,086,628	278,019,905	321,900,590	230,063,832
3. Southern Appalachian region...	39,292,052	44,454,532	42,085,941	42,154,468	49,791,197	54,189,294	57,696,763	50,846,313	58,708,985	48,674,748
4. Eastern interior field.....	76,377,174	80,016,201	75,513,359	76,991,866	87,469,224	114,113,521	121,434,557	82,771,441	119,565,243	91,063,987
5. Western interior field.....	26,580,416	27,875,292	26,396,916	25,684,804	26,474,830	30,707,592	30,723,823	21,741,003	27,677,788	17,112,893
6. Rocky Mountain region.....	28,449,860	27,327,452	24,950,285	25,434,089	30,031,648	34,209,991	36,266,503	29,411,536	36,972,403	26,462,106
7. Pacific coast region.....	3,413,902	3,951,093	3,130,352	2,482,229	3,101,493	4,098,607	4,177,546	3,069,860	3,841,674	2,544,384
Total.....	**534,466,580**	**570,048,125**	**513,525,477**	**531,619,487**	**590,098,175**	**651,402,374**	**678,211,904**	**553,952,259**	**658,264,932**	**[2] 506,395,401**

[1] No tincluding Pennsylvania anthracite field.

[2] Excluding product of wagon mines.

45335—23——3

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

MINE FATALITIES DUE TO EXPLOSIVES.

During the past 11 years mining accidents due to the use of explosives have caused 2.6 to 5.9 per cent of all fatalities at bituminous coal mines, 4.1 to 8.9 per cent at anthracite mines, 9.3 to 14.2 per cent at metal mines, and 13.6 to 26.6 per cent at quarries. No data are available regarding nonfatal accidents at coal mines, but the record shows that only 1.1 to 2 per cent of all injuries at metal mines and from 1.7 to 6.3 per cent of those at quarries have been due to the use of explosives. For every fatality due to explosives since 1911, there have been 7.5 nonfatal injuries at metal mines and 8 nonfatal injuries at quarries. Fatalities to underground employees at coal mines since 1911 are presented in Table 9; the figures (omitting 1919) show that 37 to 61 per cent of the fatalities occurred at the anthracite mines in Pennsylvania which have produced from 14 to 18 per cent of the coal tonnage of the United States. The anthracite mines normally consume from 52 to 67 per cent of all dynamite and other high explosives used at the coal mines in this country, 21 to 31 per cent of all permissible explosives, and 11 to 17 per cent of all black blasting powder. In 1919 the number of fatalities at anthracite mines was abnormally high (149, or 72 per cent), due to a powder explosion in Baltimore Tunnel No. 2, at Wilkes-Barre, on June 5, which caused the death of 92 men.

Table 10 shows the causes of fatalities and injuries due to explosives in the mining industry in 1921.

Generated on 2024-09-29 22:46 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:46 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 8.—*Fatalities and injuries due to explosives at mines and quarries, and rates per 1,000 men employed (300-day workers).*

	Bituminous coal mines.			Anthracite and bituminous coal mines.			Metal mines.						Quarries.					
	Killed.	Per cent.	Rate.	Killed.	Per cent.	Rate.	Killed.	Per cent.	Rate.	Injured.	Per cent.	Rate.	Killed.	Per cent.	Rate.	Injured.	Per cent.	Rate.
1901																		
1902																		
1903	138	9.80																
1904	121	8.64																
1905	119	7.49																
1906	115	7.27																
1907	134	5.29																
1908	109	6.17																
1909	122	5.88																
1910	113	5.09																
1911	72	3.68	0.184	160	6.02	0.299	78	11.22	0.500	531	2.00	3.40	50	26.60	0.592	341	6.33	4.04
1912	70	3.85	.171	147	6.08	.271	94	14.22	.581	573	1.86	3.54	17	22.06	.501	260	3.97	2.77
1913	63	2.91	.142	138	4.96	.232	89	13.03	.485	579	1.76	3.15	44	24.04	.505	332	4.29	3.81
1914	56	3.01	.147	146	5.95	.277	60	10.73	.421	464	1.54	3.25	35	19.44	.513	265	3.38	3.89
1915	76	4.52	.202	155	6.83	.303	78	14.10	.549	388	1.10	2.73	28	18.92	.339	227	2.35	2.75
1916	60	3.59	.139	146	6.56	.258	89	12.77	.462	870	1.80	4.52	28	16.18	.366	338	2.52	4.42
1917	55	2.60	.112	110	4.08	.173	79	9.27	.411	617	1.33	3.21	21	16.03	.294	271	2.05	3.79
1918	85	4.19	.166	135	5.23	.206	89	13.78	.492	657	1.53	3.63	17	13.60	.286	151	1.73	2.55
1919	57	3.39	.141	206	8.89	.380	48	10.26	.352	412	1.31	3.05	24	19.51	.376	167	1.81	2.62
1920	79	4.44	.168	128	5.64	.213	57	13.41	.424	496	1.52	3.69	36	20.23	.467	214	1.91	2.78
1921	84	5.83	.254	152	7.65	.320	23	10.00	.309	258	1.39	3.46	17	14.17	.283	198	1.89	3.30
1922	53	3.17	(1)	91	4.62	(1)												

[1] Not available.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TABLE 9.—*Coal-mine fatalities underground due to explosives, 1911 to 1921.*

States.	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
Pennsylvania (anthracite)	88	77	75	90	79	86	55	50	[1]149	49	68	38
Pennsylvania (bituminous)	6	8	4	7	9	10	6	6	17	22	15	10
West Virginia	3	8	8	5	6	3	6	14	6	12	14	16
Illinois	15	11	11	9	11	6	9	12	2	9	11	3
Ohio	3	5	6	2	3	5	4	8	10	10	3	5
Indiana, Michigan, and Kentucky	15	3	5	12	12	10	14	20	11	9	26	9
Alabama, Tennessee, Georgia, and North Carolina	6	6	2	2	10	3	3	5	3	6	9	1
Iowa, Kansas, and Missouri	4	14	6	4	13	9	2	7	2	3	1	.....
Colorado, New Mexico, and Utah	3	1	7	4	.....	4	3	3	1	4	.....	2
Maryland and Virginia	.....	10	2	.....	4	3	2	5	2	.....	.....	1
Montana, North Dakota, and Wyoming	4	2	4	4	3	2	2	1	2	1	.....	2
Arkansas, Oklahoma, and Texas	11	1	5	4	5	1	4	4	.....	3	3	3
Alaska, California, Idaho, Nevada, Oregon, and Washington	2	1	3	3	.....	4	.....	.....	1	.....	2	1
Total underground	**160**	**147**	**138**	**146**	**155**	**146**	**110**	**135**	**206**	**128**	**152**	**91**

[1] Of this number, 92 men were killed in the powder explosion in Baltimore Tunnel No. 2, Wilkes-Barre, Pa., on June 5, 1919.

TABLE 10.—*Fatalities and injuries due to explosives in the mineral industry, 1921.*

KILLED.

Branch of mineral industry.	Transportation.	Charging.	Suffocation.	Drilling into old holes.	Striking into loose rock or ore.	Thawing.	Caps, detonators, etc.	Unguarded shots.	Returned too soon.	Premature shots.	Sparks from match, lamp, or candle.	Delayed blast.	Shot breaking through rib or pillar.	Miscellaneous.	Total.
Quarries	....	3	....	2	....	....	....	1	....	5	....	....	....	6	17
Coal mines (underground)	7	10	28	4	3	....	2	9	12	41	9	13	2	12	152
Metal mines (underground)	....	....	1	3	....	....	....	....	2	....	....	....	....	2	8
Metal mines (open pit)	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Total	**7**	**13**	**29**	**9**	**3**	....	**2**	**10**	**14**	**46**	**9**	**13**	**2**	**21**	**178**

INJURED.

Quarries	6	14	....	11	17	1	4	1	7	35	....	8	....	94	198
Coal mines (underground)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	[1]
Metal mines (underground)	17	3	7	8	....	....	5	9	6	3	....	....	....	39	[2] 97
Metal mines (open pit)	....	....	....	....	1	....	....	1	....	2	....	....	....	1	5
Total	**23**	**17**	**7**	**19**	**18**	**1**	**9**	**11**	**13**	**40**	....	**8**	....	**134**	**300**

[1] Not available.
[2] From selected returns only. Details as to subdivisions not available for all metal mines.

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TABLE 11.—*Percentage of explosives used for various purposes in the United States during the years 1915 to 1922.*

	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.	Total.
1922.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Black blasting powder	86.5	2.4	4.3	6.8	100.00
High explosives	12.2	37.3	10.7	39.8	100.00
Permissible explosives	92.6	3.3	.4	3.7	100.00
Total	**51.1**	**19.4**	**7.0**	**22.5**	**100.00**
1921.					
Black blasting powder	87.7	2.9	2.5	6.9	100.00
High explosives	20.0	29.8	10.7	39.5	100.00
Permissible explosives	92.5	2.1	.7	4.7	100.00
Total	**57.1**	**15.2**	**6.1**	**21.6**	**100.00**
1920.					
Black blasting powder	86.2	3.4	1.9	8.5	100.00
High explosives	16.3	38.9	6.6	38.2	100.00
Permissible explosives	83.8	6.9	.5	8.8	100.00
Total	**56.2**	**18.9**	**3.7**	**21.2**	**100.00**
1919.					
Black blasting powder	85.0	3.5	2.8	8.7	100.00
High explosives	14.9	45.3	6.4	33.4	100.00
Permissible explosives	84.5	6.4	.5	8.6	100.00
Total	**51.7**	**23.6**	**4.3**	**20.4**	**100.00**
1918.					
Black blasting powder	87.7	3.0	2.2	7.1	100.00
High explosives	15.2	49.6	5.8	29.4	100.00
Permissible explosives	80.9	9.9	.4	8.8	100.00
Total	**57.1**	**22.9**	**3.5**	**16.5**	**100.00**
1917.					
Black blasting powder	85.1	3.4	4.7	6.8	100.00
High explosives	10.8	50.4	7.8	31.0	100.00
Permissible explosives	76.5	14.2	.2	9.1	100.00
Total	**51.0**	**25.4**	**5.7**	**17.9**	**100.00**
1916.					
Black blasting powder	82.1	3.6	5.0	9.3	100.00
High explosives	8.2	51.6	8.6	31.6	100.00
Permissible explosives	76.6	17.9	.3	5.2	100.00
Total	**44.4**	**28.8**	**6.5**	**20.3**	**100.00**
1915.					
Black blasting powder	84.8	3.4	3.6	8.2	100.00
High explosives	9.5	46.3	9.4	34.9	100.00
Permissible explosives	79.9	17.1	.5	2.5	100.00
Total	**45.9**	**26.1**	**6.4**	**21.5**	**100.00**

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 12.—*Production of explosives in the United States from 1912 to 1922.*

[Excluding exports.]

	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
Black blasting powder (kegs of 25 pounds):											
Quantity used for coal mining	7,483,640	7,396,683	7,072,506	6,700,558	7,079,041	9,430,012	8,648,862	6,139,605	8,790,505	5,613,435	6,190,478
Quantity used for other mining		334,014	302,885	268,146	313,851	378,199	297,818	252,134	347,223	184,792	167,700
Quantity used for railway and other construction work	1,728,095	626,474	316,131	289,869	428,853	516,892	219,260	204,197	196,172	163,688	309,819
Quantity used for all other purposes		840,510	552,466	650,319	801,256	759,638	700,594	624,506	861,293	438,935	486,652
Total	**9,211,735**	**9,197,581**	**8,243,988**	**7,908,892**	**8,623,001**	**11,084,741**	**9,866,534**	**7,220,442**	**10,195,193**	**6,400,850**	**7,154,649**
Black blasting powder (pounds):											
Quantity used for coal mining	187,091,000	184,917,075	176,812,650	167,513,950	176,976,025	235,750,300	216,221,550	153,490,125	219,762,625	140,335,875	154,761,950
Quantity used for other mining	(1)	8,350,350	7,572,125	6,703,650	7,846,275	9,454,975	7,445,450	6,303,350	8,680,575	4,619,800	4,192,500
Quantity used for railway and other construction work	18,533,000	15,661,850	7,903,275	7,246,725	10,721,325	12,922,300	5,481,500	5,104,925	4,904,300	4,092,200	7,745,475
Quantity used for all other purposes	[2] 24,669,375	21,010,250	13,811,650	16,257,975	20,031,400	18,990,950	17,514,850	15,612,650	21,532,325	10,973,375	12,166,300
Total	**230,293,375**	**229,939,525**	**206,099,700**	**197,722,300**	**215,575,025**	**277,118,525**	**246,663,350**	**180,511,050**	**254,879,825**	**160,021,250**	**178,866,225**
High explosives other than permissible (pounds):											
Quantity used for coal mining	20,903,430	24,143,133	24,215,945	22,384,025	20,901,405	28,262,807	31,368,073	29,616,383	37,273,255	34,231,542	25,497,758
Quantity used for other mining	89,703,081	92,096,426	84,264,577	109,128,966	131,753,648	132,235,515	102,366,876	89,754,788	89,132,316	50,977,366	78,074,489
Quantity used for railway and other construction work		33,173,805	27,983,946	22,279,699	21,905,376	20,418,227	12,081,541	12,759,623	15,052,608	18,317,333	22,434,206
Quantity used for all other purposes	123,862,981	92,973,180	81,989,503	82,035,897	80,594,358	81,399,531	60,599,587	66,137,794	87,653,905	67,426,161	83,469,631
Total	**234,469,492**	**242,386,544**	**218,453,971**	**235,828,587**	**255,154,787**	**262,316,080**	**206,416,077**	**198,268,588**	**229,112,084**	**170,952,402**	**209,476,084**

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:46 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Permissible explosives (pounds):											
Quantity used for coal mining	18,150,618	21,804,285	19,593,892	21,841,659	26,566,521	32,910,397	37,262,915	32,840,196	45,222,130	38,055,650	40,197,939
Quantity used for other mining	4,668,399	4,735,480	4,850,241	4,687,510	6,206,558	6,102,225	4,550,130	2,498,132	3,750,585	881,710	1,452,500
Quantity used for railway and other construction work	1,811,253	424,575	281,425	139,843	97,100	106,185	183,380	183,353	266,505	262,545	154,112
Quantity used for all other purposes		721,430	972,260	680,897	1,815,061	3,921,915	4,048,808	3,333,151	4,723,621	1,933,946	1,625,217
Total	**24,630,270**	**27,685,770**	**25,697,818**	**27,349,909**	**34,685,240**	**43,040,722**	**46,045,233**	**38,854,832**	**53,962,841**	**41,133,851**	**43,429,768**
Grand total (pounds):											
Quantity used for coal mining	226,145,048	230,864,493	220,622,487	211,739,634	224,443,951	296,923,504	284,852,538	215,946,704	302,258,010	212,623,067	220,457,647
Quantity used for other mining	137,573,855	105,182,256	96,686,943	120,520,126	145,806,481	147,792,715	114,362,456	98,556,270	101,563,476	56,478,876	83,719,489
Quantity used for railway and other construction work		49,260,230	36,168,646	29,666,267	32,723,801	33,446,712	17,746,421	18,047,901	20,223,413	22,672,078	30,333,793
Quantity used for all other purposes	125,674,234	114,704,860	96,773,413	98,974,769	102,440,819	104,312,396	82,163,245	85,083,595	113,909,851	80,333,482	97,261,148
Total	**489,393,137**	**500,011,839**	**450,251,489**	**460,900,796**	**505,415,052**	**582,475,327**	**499,124,660**	**417,634,470**	**537,954,750**	**372,107,503**	**431,772,077**

[1] Included in quantity used for all other purposes.

[2] Includes quantity used for other mining.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 12A.—*Monthly sales of explosives in 1922, by uses.*[1]

[Excluding exports.]

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Black blasting powder (kegs of 25 pounds):												
Quantity used for coal mining	452,966	481,613	383,240	134,125	194,022	207,314	231,209	497,053	717,341	700,191	637,304	554,871
Quantity used for other mining	9,693	11,549	9,163	9,149	18,674	19,416	20,083	18,788	15,048	11,792	8,043	8,405
Quantity used for railway and other construction work	11,677	14,516	17,740	22,035	27,637	29,577	26,219	33,905	27,442	33,799	28,221	24,223
Quantity used for all other purposes	34,399	29,806	19,915	20,344	33,997	39,330	38,944	54,096	54,844	47,323	41,576	34,143
Total	**508,735**	**537,484**	**430,058**	**185,653**	**274,330**	**295,637**	**316,455**	**603,842**	**814,675**	**793,105**	**715,144**	**621,642**
Black blasting powder (pounds):												
Quantity used for coal mining	11,324,150	12,040,325	9,581,000	3,353,125	4,850,550	5,182,850	5,780,225	12,426,325	17,933,525	17,504,775	15,932,600	13,871,775
Quantity used for other mining	242,325	288,725	229,075	228,725	466,850	485,400	502,075	469,700	376,200	294,800	201,075	210,125
Quantity used for railway and other construction work	291,925	362,900	443,500	550,875	690,925	739,425	655,475	847,625	686,050	844,975	705,525	605,575
Quantity used for all other purposes	859,975	745,150	497,875	508,600	849,925	983,250	973,600	1,352,400	1,371,100	1,183,075	1,039,400	853,575
Total	**12,718,375**	**13,437,100**	**10,751,450**	**4,641,325**	**6,858,250**	**7,390,925**	**7,911,375**	**15,096,050**	**20,366,875**	**19,827,625**	**17,878,600**	**15,541,050**
High explosives other than permissible (pounds):												
Quantity used for coal mining	2,126,699	2,514,138	2,391,440	495,250	484,314	656,128	651,673	983,956	2,619,004	3,164,785	2,987,639	3,033,093
Quantity used for other mining	4,433,645	4,663,548	5,457,377	5,286,653	5,892,943	5,881,520	6,354,560	7,323,831	6,994,020	6,691,540	7,215,885	6,832,966
Quantity used for railway and other construction work	1,132,122	1,227,128	1,455,116	1,484,617	1,903,700	1,757,225	1,958,594	2,891,277	2,347,960	2,023,697	1,739,227	1,469,834
Quantity used for all other purposes	3,498,784	3,182,492	4,110,815	6,843,536	6,876,441	5,988,166	6,094,858	6,915,889	5,768,005	6,259,096	5,632,151	3,961,854
Total	**11,191,250**	**11,587,306**	**13,414,748**	**14,110,056**	**15,157,398**	**14,283,039**	**15,059,685**	**18,114,953**	**17,728,989**	**18,139,118**	**17,574,902**	**15,297,747**

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:44 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Permissible explosives (pounds):												
Quantity used for coal mining	2,686,910	3,182,288	3,214,466	1,401,132	1,210,450	2,076,951	1,771,075	2,850,425	4,400,872	4,520,440	4,356,760	3,812,670
Quantity used for other mining	2,800	46,000	71,300	76,250	138,300	246,800	205,900	226,050	262,250	70,250	114,000	175,250
Quantity used for railway and other construction work	7,650	9,300	17,375	14,575	3,500	9,612	5,950	19,225	5,650	26,025	8,150	15,250
Quantity used for all other purposes	103,400	94,775	127,075	169,000	93,307	59,162	100,067	185,100	231,925	75,345	137,034	69,640
Total	**2,800,760**	**3,332,363**	**3,430,216**	**1,660,957**	**1,445,557**	**2,392,525**	**2,082,992**	**3,280,800**	**4,900,697**	**4,692,060**	**4,615,944**	**4,072,810**
Grand total (pounds):												
Quantity used for coal mining	16,137,759	17,736,751	15,186,906	5,249,507	6,545,314	7,915,929	8,202,973	16,260,706	24,953,401	25,190,000	23,276,999	20,717,538
Quantity used for other mining	4,678,770	4,998,273	5,757,752	5,591,628	6,498,093	6,613,720	7,062,535	8,019,581	7,632,470	7,056,590	7,530,960	7,218,341
Quantity used for railway and other construction work	1,431,697	1,599,328	1,915,991	2,050,067	2,598,125	2,506,262	2,620,019	3,758,127	3,039,660	2,894,697	2,452,902	2,090,659[1]
Quantity used for all other purposes	4,462,159	4,022,417	4,735,765	7,521,136	7,819,673	7,030,578	7,168,525	8,453,389	7,371,030	7,517,516	6,808,585	4,885,069
Total	26,710,385	28,356,769	27,596,414	20,412,338	23,461,205	24,066,489	25,054,052	36,491,803	42,996,561	42,658,803	40,069,446	34,911,607

[1] The monthly sales of explosives in 1922 add to less than the total sales shown for the year because several manufacturers did not report their sales on a monthly basis.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

MONTHLY SALES OF EXPLOSIVES.

Table 13 shows the monthly fluctuations in the sales of explosives during the past three years. It is based mainly on monthly reports by manufacturers who are members of the Institute of Makers of Explosives, although the figures for 1922 include some companies not members of the institute. The figures for 1922 are for companies whose sales represented more than 85 per cent of all sales of black blasting powder, 87 per cent of high explosives (other than permissibles), and over 89 per cent of permissible explosives. Reports from most nonmembers are received by the Bureau of Mines in the form of an annual summary, hence the data for those companies could not be segregated on a monthly basis.

The standard chosen for purposes of comparison was the average monthly sales during the year, and this quantity was rated at 100. The sales for each month were then calculated as a certain percentage of this standard.

An examination of the table shows clearly how closely the months of low sales of explosives, particularly permissibles and black powder, coincided with the months of low production of coal during the general strike in the coal mining industry which extended from the first of April to the latter part of August. Sales of high explosives other than permissibles were not affected so much by the strike because this class of explosives is not used to any great extent in coal mining except in the anthracite mines of Pennsylvania.

Table 14 shows the monthly fluctuation of sales of explosives during 1922 with reference to the purposes for which the explosives were used.

Generated on 2024-09-29 22:46 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TABLE 13.—*Monthly fluctuations in sales of explosives and in production of coal, 1922, 1921, and 1920.*

[Average monthly quantities equal 100 per cent.]

Month.	Sales of explosives.			Production of coal.		
	Black blasting powder.	"High" explosives.	Permissible explosives.	Bituminous.	Anthracite.	Total.
1922.						
January	100.1	73.9	86.8	110.6	143.1	114.3
February	105.8	76.5	103.3	120.6	154.6	124.4
March	84.7	88.6	106.3	147.6	200.2	153.6
April	36.5	93.2	51.5	46.4	.6	41.2
May	54.0	100.1	44.8	59.7	.8	53.0
June	58.2	94.3	74.2	65.6	1.9	58.4
July	62.3	99.5	64.6	50.0	2.7	44.6
August	118.9	119.7	101.7	80.5	3.7	71.7
September	160.4	117.1	151.9	116.2	111.9	115.7
October	156.1	119.8	145.5	132.8	196.1	140.0
November	140.8	116.1	143.1	133.3	191.7	139.9
December	122.4	101.1	126.3	136.7	192.7	143.0
1921.						
January	109.3	93.0	128.8	118.7	100.6	115.4
February	87.5	92.3	83.8	90.9	104.5	93.3
March	80.2	105.0	83.0	89.5	100.5	91.5
April	80.4	108.4	78.8	81.2	104.5	85.3
May	88.2	105.6	99.3	98.2	104.1	99.3
June	103.7	97.0	105.0	99.9	112.0	102.0
July	91.5	89.1	93.5	89.5	95.7	90.6
August	109.4	106.1	100.8	101.8	103.9	102.2
September	113.4	110.4	98.6	103.5	96.7	102.3
October	132.2	114.0	126.7	128.9	102.9	124.2
November	118.6	93.0	106.1	106.1	93.1	103.8
December	85.1	85.6	95.3	91.3	81.2	89.5
1920.						
January	109.1	87.9	99.9	105.0	102.2	104.6
February	99.4	103.1	87.1	86.5	87.9	86.7
March	107.6	126.7	98.4	100.9	105.8	101.6
April	74.6	107.0	82.3	81.8	83.8	82.1
May	95.2	108.8	94.7	85.7	107.2	88.7
June	114.7	107.5	98.8	94.4	110.0	96.5
July	109.2	93.7	103.5	98.2	111.3	100.0
August	108.8	120.6	113.3	104.3	108.1	104.8
September	92.6	105.1	116.6	106.1	[1] 62.6	100.1
October	108.4	94.5	115.1	113.5	108.7	112.8
November	91.3	74.4	94.3	110.0	100.4	108.7
December	89.1	70.7	96.2	113.7	112.1	113.5

[1] A strike in the anthracite field restricted output.

Generated on 2024-09-29 22:44 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TABLE 14.—*Monthly fluctuations in sales of explosives in 1922, by uses.*

[Average monthly quantities equal 100 per cent.]

Month.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.	Month.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.
BLACK BLASTING POWDER.					HIGH EXPLOSIVES—continued.				
January	104.71	72.79	47.18	91.99	July	35.37	104.42	109.88	112.29
February	111.33	86.72	58.65	79.71	August	53.41	120.34	162.20	127.42
March	88.59	68.81	71.68	53.26	September	142.16	114.93	131.72	106.27
April	31.00	68.70	89.03	54.41	October	171.78	109.95	113.53	115.32
May	44.85	140.23	111.67	90.92	November	162.17	118.57	97.57	103.77
June	47.92	145.80	119.51	105.18	December	164.63	112.28	82.46	72.99
July	53.45	150.81	105.94	104.15					
August	114.90	141.08	137.00	144.67	PERMISSIBLES.				
September	165.82	113.00	110.88	146.67					
October	161.85	88.55	136.57	126.56	January	90.86	2.05	64.53	85.82
November	147.33	60.40	114.03	111.19	February	107.62	33.76	78.45	78.66
December	128.26	63.11	97.87	91.31	March	108.71	52.33	146.56	105.47
					April	47.38	55.96	122.94	140.27
HIGH EXPLOSIVES.					May	40.93	101.04	29.52	77.44
					June	70.24	181.12	81.08	49.10
January	115.43	72.85	63.51	64.46	July	59.89	151.10	50.19	83.05
February	136.46	76.63	68.84	58.63	August	96.39	165.89	162.17	153.62
March	129.80	89.68	81.63	75.74	September	148.83	192.46	47.66	192.49
April	26.88	86.87	83.29	126.09	October	152.87	51.55	219.52	62.53
May	26.29	96.83	106.80	126.69	November	147.34	83.66	68.75	113.73
June	35.61	96.64	98.58	110.33	December	128.94	128.61	128.64	57.80

CAPACITY OF MILLS.

Reports from manufacturers whose sales of black powder in 1922 represented about 74 per cent of the total sales by all companies showed that their plants ran at 42 per cent of capacity during the year. Similar information from manufacturers of permissibles and other high explosives, whose sales represented 85 per cent of this branch of the explosives industry, showed that the quantity of explosives manufactured during 1922 was 52 per cent of the capacity of the mills reporting. The monthly fluctuations in the quantities of explosives manufactured, sales, shipments, etc., are shown in Table 15.

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 15.—*Relation between quantity of explosives manufactured and sold and mill capacity in 1922.*

BLACK BLASTING POWDER.

[Quantities in kegs.]

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Capacity	1,048,533	1,028,533	1,028,533	1,037,666	1,037,666	1,037,666	1,037,666	1,037,666	1,037,666	1,037,666	1,047,666	1,047,666	12,464,593
Manufactured	332,796	427,258	387,754	149,948	229,429	317,646	334,708	503,212	656,717	694,567	678,541	572,104	5,284,680
Percentage of capacity	31.74	41.54	37.69	14.45	22.11	30.61	32.26	48.49	63.29	66.94	64.77	54.61	42.40
Shipments	428,990	490,420	348,740	173,478	253,918	261,538	319,554	565,959	729,142	703,637	651,828	542,062	5,469,266
Percentage of capacity	40.91	47.68	33.91	16.72	24.47	25.20	30.80	54.54	70.27	67.81	62.22	51.74	43.88
Sales	420,489	445,992	359,521	160,412	237,167	266,449	293,737	532,000	707,467	689,197	612,780	539,250	5,264,461
Percentage of capacity	40.10	43.36	34.95	15.46	22.86	25.68	28.30	51.26	68.18	66.42	58.49	51.47	42.23
Stocks, end of month	491,970	414,440	429,238	409,699	411,768	468,227	482,965	423,871	352,337	344,146	373,324	406,950	406,950
Percentage of capacity	46.92	40.29	41.73	39.48	39.68	45.12	46.54	40.84	33.95	33.17	35.63	38.84	3.26

PERMISSIBLES AND OTHER HIGH EXPLOSIVES.

[Quantities in pounds.]

Capacity	38,113,333	38,113,333	38,113,333	38,373,333	38,373,333	38,373,333	38,373,332	38,425,332	38,425,332	38,425,332	38,503,332	38,503,332	460,115,990
Manufactured	13,843,327	15,971,807	17,469,176	16,538,355	17,228,257	17,743,842	20,110,747	24,031,197	23,563,820	25,935,334	23,662,356	20,950,293	237,048,511
Percentage of capacity	36.32	41.91	45.83	43.10	44.90	46.24	52.41	62.54	61.32	67.50	61.46	54.41	51.52
Shipments	13,929,313	16,126,577	17,699,281	16,151,058	18,077,036	17,079,455	19,805,985	23,360,956	23,795,059	25,134,236	23,753,754	21,315,099	236,227,899
Percentage of capacity	36.55	42.31	46.44	42.09	47.11	44.51	51.61	60.80	61.93	65.41	61.69	55.36	51.34
Sales	13,745,631	14,501,276	16,565,942	15,488,225	16,238,129	16,227,977	16,665,255	20,837,478	22,170,680	22,288,742	21,729,023	19,040,255	215,498,613
Percentage of capacity	36.07	38.05	43.46	40.36	42.32	42.29	43.43	54.23	57.69	58.01	56.43	49.45	46.83
Stocks, end of month	5,548,535	5,264,195	5,118,090	5,674,356	4,850,691	5,503,823	5,660,671	6,363,537	6,135,450	6,992,733	6,897,492	6,559,471	6,559,471
Percentage of capacity	14.56	13.81	13.43	14.79	12.64	14.34	14.75	16.56	15.97	18.20	17.91	17.04	1.43

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

PUBLICATIONS ON INVESTIGATIONS OF EXPLOSIVES.

A limited supply of the following publications of the Bureau of Mines has been printed and is available for free distribution until the edition is exhausted. Requests for all publications can not be granted, and to insure equitable distribution applicants are requested to limit their selection to publications that may be of especial interest to them. Requests for publications should be addressed to the Director, Bureau of Mines.

The Bureau of Mines issues a list showing all its publications available for free distribution as well as those obtainable only from the Superintendent of Documents, Government Printing Office, on payment of the price of printing. Interested persons should apply to the Director, Bureau of Mines, for a copy of the latest list.

PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION.

BULLETIN 17. A primer on explosives for coal miners, by C. E. Munroe and Clarence Hall. 1911. 61 pp., 10 pls., 12 figs.

BULLETIN 48. The selection of explosives used in engineering and mining operations, by Clarence Hall and S. P. Howell. 1914. 50 pp., 3 pls., 7 figs.

BULLETIN 59. Investigations of detonators and electric detonators, by Clarence Hall and S. P. Howell. 1913. 73 pp., 7 pls., 5 figs.

BULLETIN 80. A primer on explosives for metal miners and quarrymen, by C. E. Munroe and Clarence Hall. 1915. 125 pp., 51 pls., 17 figs.

BULLETIN 96. The analysis of permissible explosives, by C. G. Storm. 1916. 88 pp., 3 pls., 7 figs.

BULLETIN 137. The use of permissible explosives in the coal mines of Illinois, by J. R. Fleming and J. W. Koster. 1917. 106 pp.

BULLETIN 196. Coal-mine fatalities in the United States, 1919, and coal-mine statistics supplementing those published in Bulletin 115, with list of permissible explosives, lamps, and motors tested prior to Jan. 31, 1920, by A. H. Fay. 1920. 86 pp.

BULLETIN 198. Regulation of explosives in the United States, by C. E. Munroe. 1921. 45 pp.

TECHNICAL PAPER 7. Investigations of fuse and miners' squibs, by Clarence Hall and S. P. Howell. 1912. 19 pp.

TECHNICAL PAPER 17. The effect of stemming on the efficiency of explosives, by W. O. Snelling and Clarence Hall. 1912. 20 pp., 11 figs.

TECHNICAL PAPER 78. Specific gravity separation applied to the analysis of mining explosives, by C. G. Storm and A. L. Hyde. 1914. 14 pp.

TECHNICAL PAPER 89. Coal-tar products and the possibility of increasing their manufacture in the United States, by H. C. Porter, with a chapter on coal-tar products used in explosives, by C. G. Storm. 1915. 21 pp.

TECHNICAL PAPER 125. The sand test for determining the strength of detonators, by C. G. Storm and W. C. Cope. 1916. 68 pp., 2 pls., 5 figs.

TECHNICAL PAPER 145. Sensitiveness to detonation of trinitrotoluene and tetranitromenthylanilin, by G. B. Taylor and W. C. Cope. 1916. 11 pp.

TECHNICAL PAPER 160. The determination of nitrogen in substances used in explosives, by W. C. Cope and G. B. Taylor. 1917. 46 pp., 1 pl., 4 figs.

TECHNICAL PAPER 162. Initial priming substances for high explosives, by G. B. Taylor and W. C. Cope. 1917. 32 pp.

Generated on 2024-09-29 22:45 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TECHNICAL PAPER 186. Methods of routine work in the explosives physical laboratory of the Bureau of Mines, by S. P. Howell and J. E. Tiffany. 1918. 63 pp.

TECHNICAL PAPER 210. An analytical method for detecting blown-out shots in coal mines, by G. F. Hutchinson and J. Barab. 1919. 22 pp.

TECHNICAL PAPER 234. Sensitiveness of explosives to frictional impact, by S. P. Howell. 1919. 17 pp., 2 pls., 1 fig.

TECHNICAL PAPER 243. Development of liquid oxygen explosives during the war, by G. S. Rice. 1920. 46 pp., 2 pls., 6 figs.

TECHNICAL PAPER 291. Production of explosives in the United States during the calendar year 1920, by W. W. Adams. 1921. 44 pp., 4 figs.

TECHNICAL PAPER 313. Production of explosives in the United States during the fiscal year 1921, by W. W. Adams. 1922. 44 pp., 1 fig.

MINERS' CIRCULAR 7. Use and misuse of explosives in coal mining, by J. J. Rutledge, with a preface by J. A. Holmes. 1913. 52 pp., 8 figs.

MINERS' CIRCULAR 19. The prevention of accidents from explosives in metal mining, by Edwin Higgins. 1914. 16 pp., 11 figs.

PUBLICATIONS THAT MAY BE OBTAINED ONLY THROUGH THE SUPERINTENDENT OF PUBLIC DOCUMENTS.

BULLETIN 10. The use of permissible explosives, by J. J. Rutledge and Clarence Hall. 1912. 34 pp., 5 pls., 4 figs. 10 cents.

BULLETIN 15. Investigations of explosives used in coal mines, by Clarence Hall, W. O. Snelling, and S. P. Howell, with a chapter on the natural gas used at Pittsburgh, by G. A. Burrell, and an introduction by C. E. Munroe. 1911. 197 pp., 7 pls., 5 figs. 25 cents.

BULLETIN 51. The analysis of black powder and dynamite, by W. O. Snelling and C. G. Storm. 1913. 80 pp., 5 pls., 5 figs. 10 cents.

BULLETIN 66. Tests of permissible explosives, by Clarence Hall and S. P. Howell, 1913. 313 pp., 1 pl., 6 figs. 25 cents.

TECHNICAL PAPER 12. The behavior of nitroglycerin when heated, by W. O. Snelling and C. G. Storm. 1912. 14 pp., 1 pl., 2 figs. 5 cents.

TECHNICAL PAPER 18. Magazines and thaw houses for explosives, by Clarence Hall and S. P. Howell. 1912. 34 pp., 1 pl., 5 figs. 10 cents.

TECHNICAL PAPER 69. Production of explosives in the United States during the calendar year 1912, compiled by A. H. Fay. 1914. 8 pp. 5 cents.

TECHNICAL PAPER 146. The nitration of toluene, by E. J. Hoffman. 1916. 32 pp. 5 cents.

TECHNICAL PAPER 159. Production of explosives in the United States during the calendar year 1915, with notes on coal-mine accidents due to explosives, and a list of permissible explosives, lamps, and motors tested prior to June 1, 1916, compiled by A. H. Fay. 1916. 24 pp. 5 cents.

TECHNICAL PAPER 169. Permissible explosives tested prior to Jan. 1, 1917, by S. P. Howell. 1917. 19 pp. 5 cents.

TECHNICAL PAPER 175. Production of explosives in the United States during the calendar year 1916, by A. H. Fay. 1917. 24 pp. 5 cents.

TECHNICAL PAPER 192. Production of explosives in the United States during the calendar year 1917, with notes on coal-mine accidents due to explosives and list of permissible explosives tested prior to Apr. 30, 1918, by A. H. Fay. 1918. 5 cents.

TECHNICAL PAPER 231. Production of explosives in the United States during the calendar year 1918, by A. H. Fay. 1919. 21 pp. 5 cents.

Generated on 2024-09-29 22:49 GMT / https://hdl.handle.net/2027/uiug.30112111813504
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN